

Valuing Native Maize and Indigenous Communities



Participatory Plant Breeding and Resilient Seed System Development:
Options for Stakeholder Engagement and Benefit Sharing

1 December 2020
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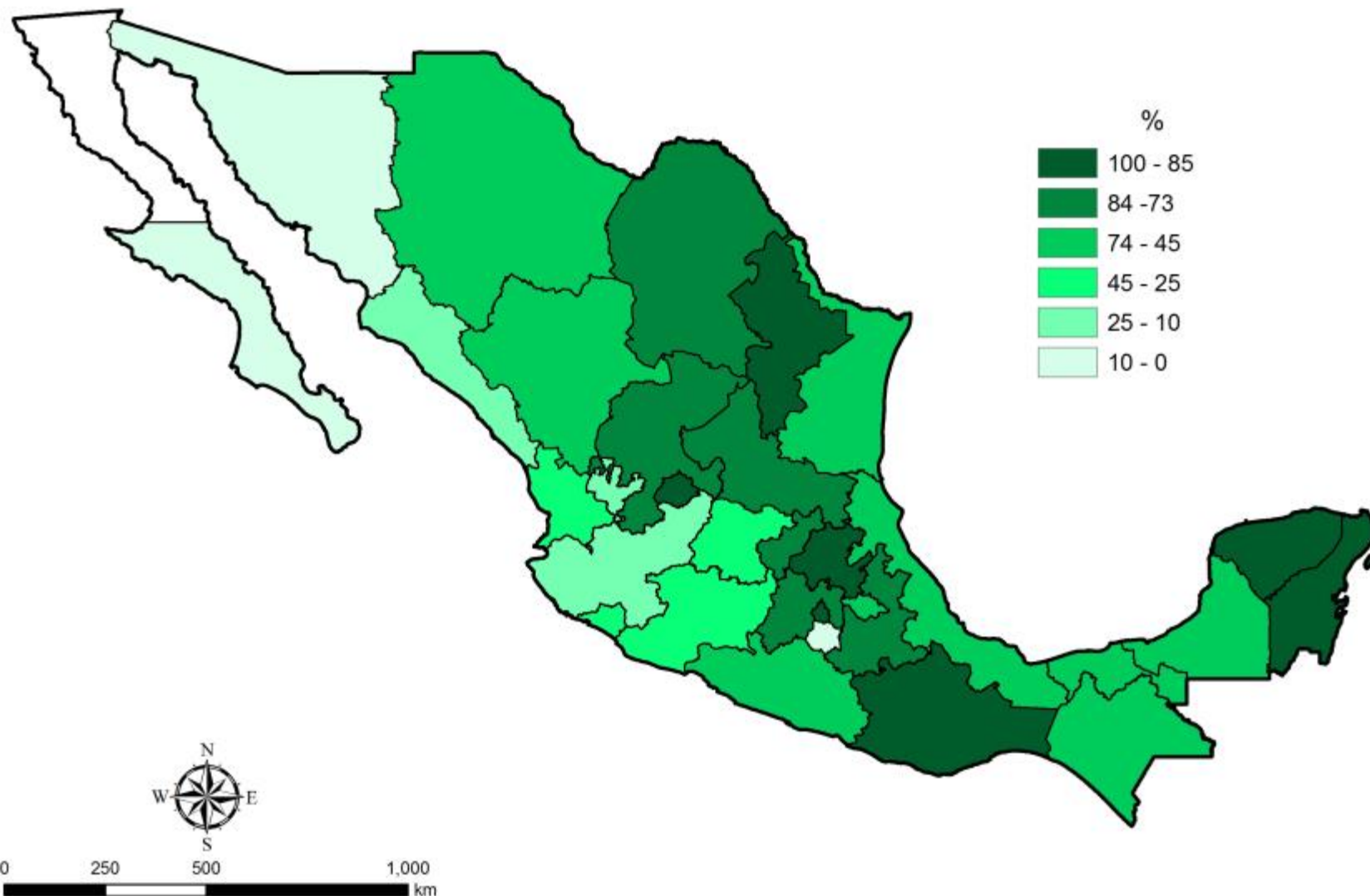
Maize Diversity

There is often more diversity in a single village in Mexico than in the entire country of the United States.

Edgar Anderson, 1946




Percentage of Area Sown to Non-Improved Maize



Fuente: SIAP, 2012. Estadística de uso tecnológico y de servicios en la superficie agrícola.
Disponible en: <http://www.siap.gob.mx/tecnificacion/>

Diversity of Culinary Uses



Nicuatole

A photograph showing several slices of white, slightly translucent cornmeal-based bread, some with a red powder coating, arranged on a white plate.




Gorditas

A photograph of a person's hands cooking gorditas on a large, dark, circular griddle. The gorditas are small, round, and some are filled with green sauce and other ingredients.



Tlacoyos

A photograph showing several dark, oval-shaped tortillas, some with a lighter center, arranged on a dark surface.




Pozole

A photograph of a bowl of green pozole, a traditional Mexican soup made with hominy, pork, and green chilies, garnished with red and green vegetables.



Tamales

A photograph of several tamales, which are cornmeal-based doughs filled with various ingredients, wrapped in corn husks, and tied with string.



Empanadas

A photograph of a person's hands shaping an empanada on a large, round, flat griddle. The empanada is a half-moon shape filled with a mixture of ingredients.



Esquites



Coricos



Pinole



Corundas



Pozol

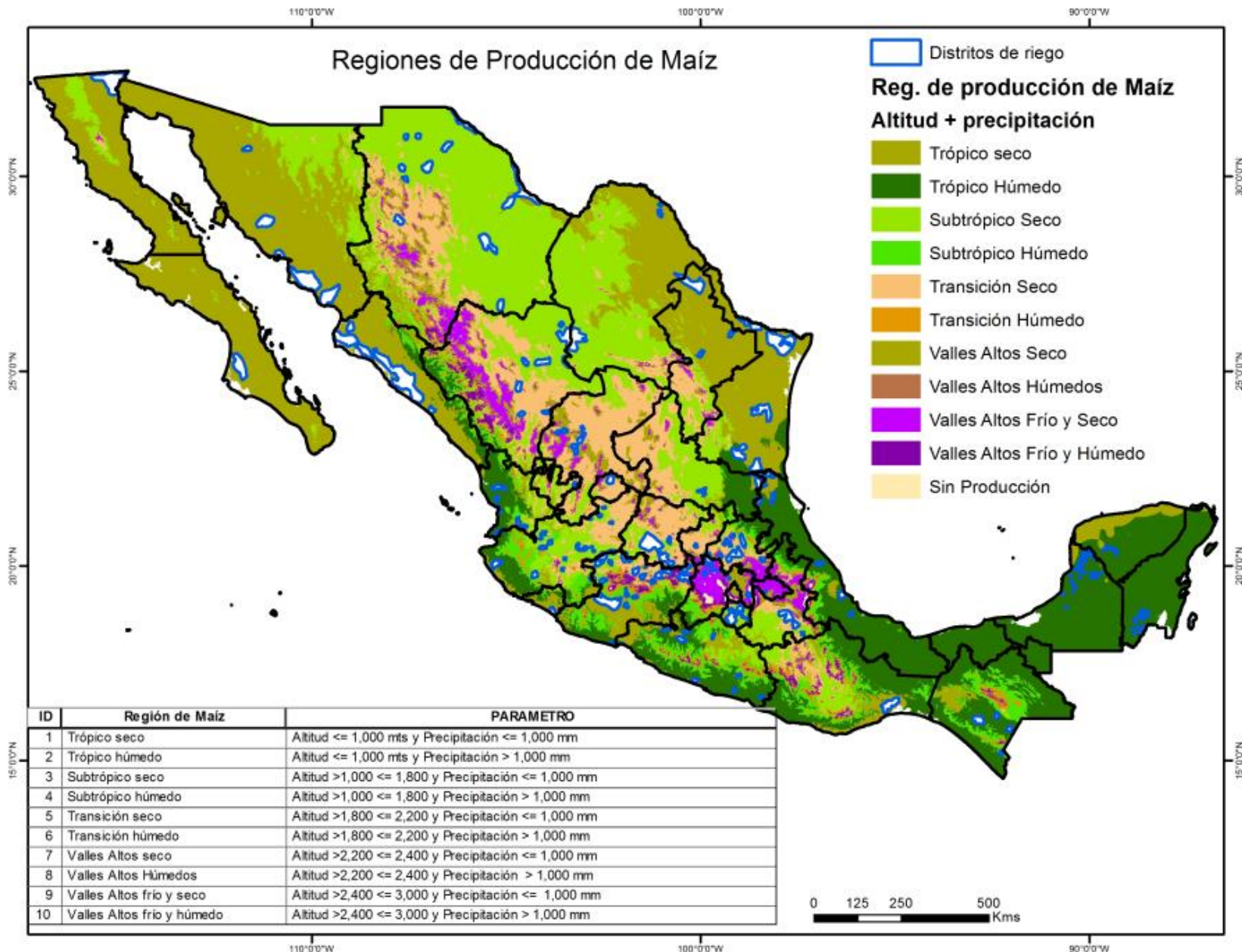


Tejate



Atole

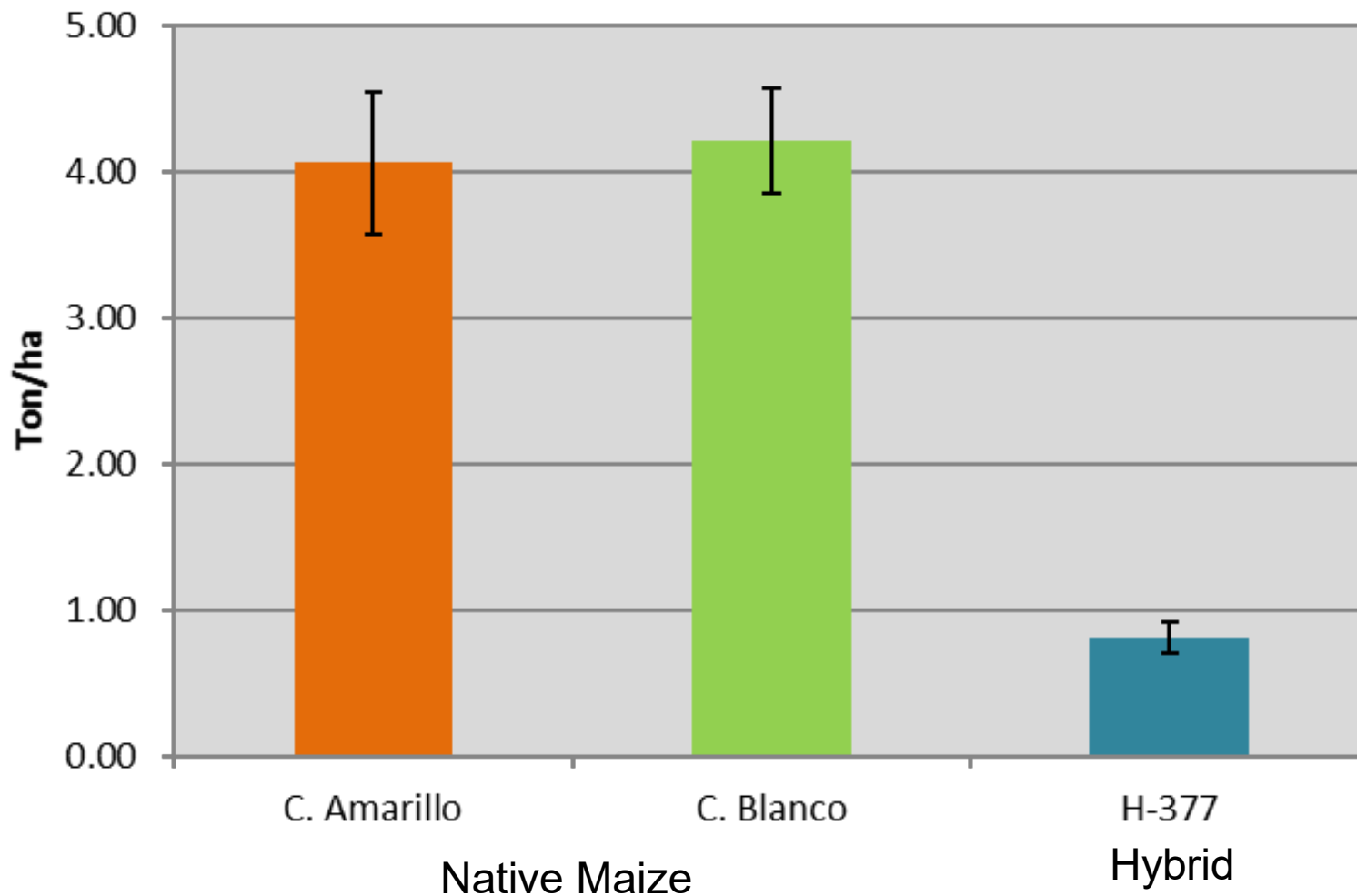
Regiones de Producción de Maíz



Environments too Small and Specific to be Served by Hybrid Breeding Programs



Yields in Santiago Yaitepec of Native Maize and Hybrid



Maize Landrace Improvement Project has focused on improving food security of subsistence farmers



Characteristics of subsistence farming in Mexico

- Save and select seed
- Consume their own grain
- Inherit seed from their ancestors
- Grow multiple races, colors, and textures in a single village for specific dishes
- Plant to have enough to feed their family.
- Are reticent to invest time and resources in producing excess grain if there is no clear market.



Collaborators



**M.C. Flavio
Aragón
INIFAP**



**Ing. Humberto
Castro
UACH**



**M.C. Leodegario
Osorio
INIFAP**



**Dra. Martha Willcox
CIMMYT**



Community Based Participatory Plant Improvement



Participatory Plant Breeding



Photo: Flavio Aragon



Planting of Farmer Seed Samples within the Community



Training Courses





Harvest





Field Day Demonstrations



Community Evaluation

Participatory Improvement of Native Maize in Marginalized Areas of Oaxaca: San Antonio Nduayaco

Altitude: 2300 masl

Climate: Highland semi-arid

Index of Extreme Poverty: 49%

Migration Rate: 60%

Soil Type: stony, red sandy loam, 2.3% OM, 20% slope, low in potassium, pH6.0

Biotic Stresses: White Grubs, Tar Spot, Turcicum

Type of Maize: Chalqueño (cajete), Conico (temporal)

Abiotic Stresses: Drought, Frosts

Planting Systems

San Antonio Nduayaco

Cajete- Deep planting 1-3 months before initiation of rains



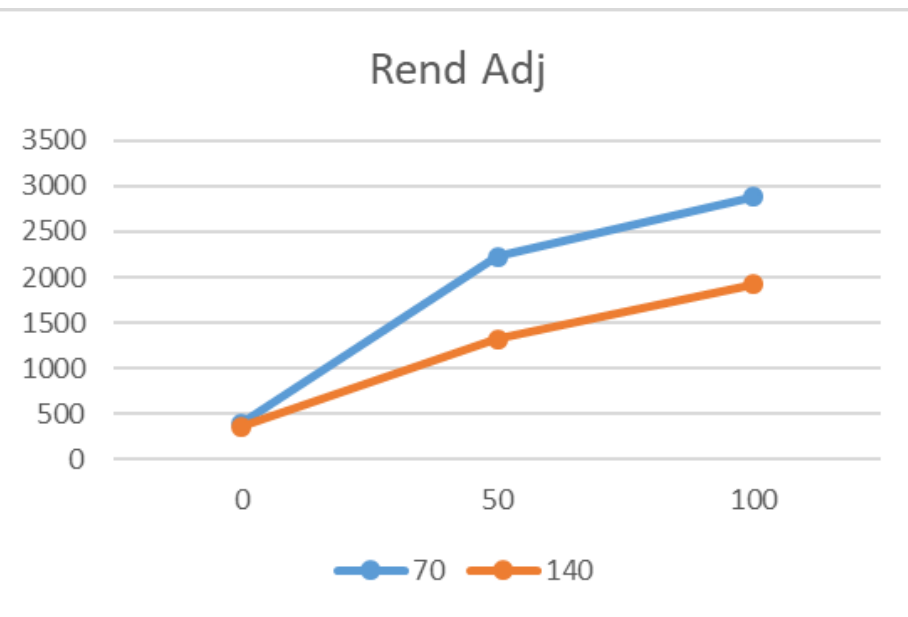
Temporal – at initiation of rains



Trials of Plant Spacing and Fertility in the Cajete System

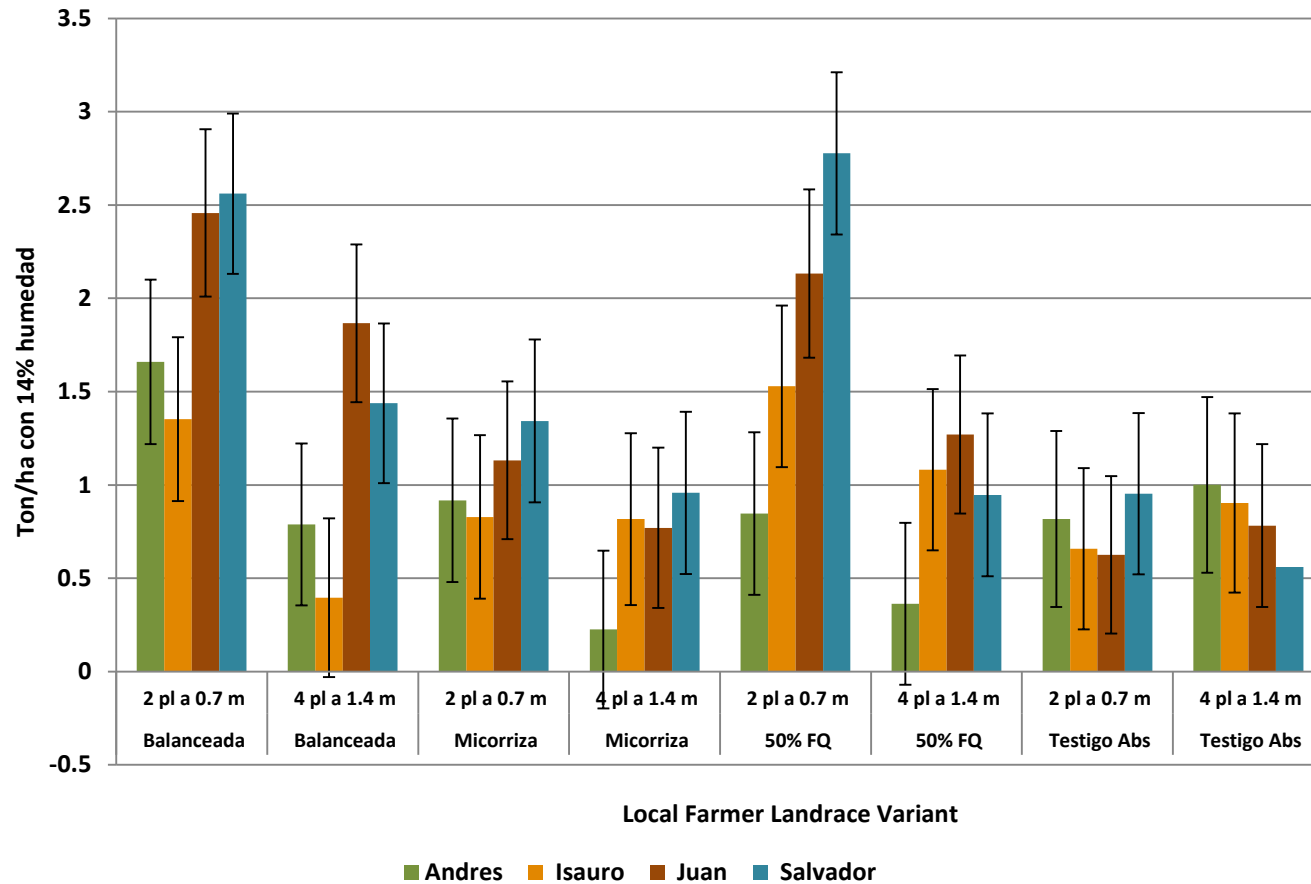
Cajete- Deep planting 1-3 months before initiation of rains

Grain yield at 70 and 140 cm with 0, 50, and 100% of fertilization



Genotype Management Interaction

Maiz de Cajete San Antonio Nduayaco



Production Costs of Treatments

		No fertilizer	Fert. 50% (3.6-20-25 NPK)	Fert. 100% (7.2-40-50 NPK)	Mycorrhiza
Land Preparation					
Plowing \$350/team	4 teams/ha	1400	1400	1400	1400
Planting					
Landrace Seed \$7/kg	22 kg/ha	154	154	154	154
Labor \$150/day	12	1800	1800	1800	1800
Fertilization					
18-46-0		0	418.47	836.94	0
KCL			352.8	705.6	0
Micorriza		0	0	0	150
Application Labor	\$150/ person	0	150	300	0
Transport fertilizer	\$ 50/sack	0	85.5	171	0
Pest Control					
Seed Treatment		372.6	372.6	372.6	372.6
Cultivation \$300/team	2 teams/ha	600	600	600	600
Labor \$150/day	3	450	450	450	450
Manual weeding	4 laborers	600	600	600	600
Karate (2 aplic)	0.25 lt/ha		300	300	
Aplication Labor	\$ 150/person		300	300	
Harvest					
Labor	\$ 150/person	300	600	750	600
Shelling		300	600	750	600
Transport from field			300	600	
Total (\$/ha)		5976.6	8483.37	10090.14	6726.6

Agronomic Trials

- **Association Trials: Maize with intercalated legumes**
- **Seed Treatment Trials: Comparasion of biological, chemical, and no treatment on maize yield.**
- **Rotation trials: Green manures compared to maize after maize.**



Maize Trials with Associated Beans, Santiago Yaitepec, Juquila, 2016.



MasAgro: Landrace Breeding

Between 2014 and 2019:

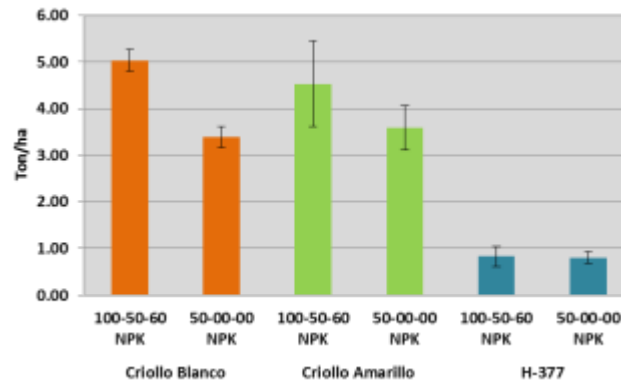
- 165 trials and nurseries in 3 states (Oaxaca, Michoacán, State of Mexico)
- 162 farmer training courses for more than 2,365 farmers from 111 communities in Oaxaca





Participatory Selection

Genetic and Agronomic improvement of native maize in Oaxaca, México



Agronomic Improvement



Market Access

FALL PREVIEW 2014

Enrique Olvera to Serve 'Single-Origin' Tortilla at Cosme, Opening Next Week

By Robin Raisfeld and Rob Patronite

end user



Enrique Olvera of Best New Restaurant in NYC Cosme



Restaurant Review: Cosme in the Flatiron District

There are no tortillas remotely like this in New York. Cosme makes them downstairs in the kitchen from old strains of blue, yellow, purple and white corn grown in Mexico.



Maize CRP Funding: Connecting Farmers to Culinary Markets



Native Maize Landrace Improvement

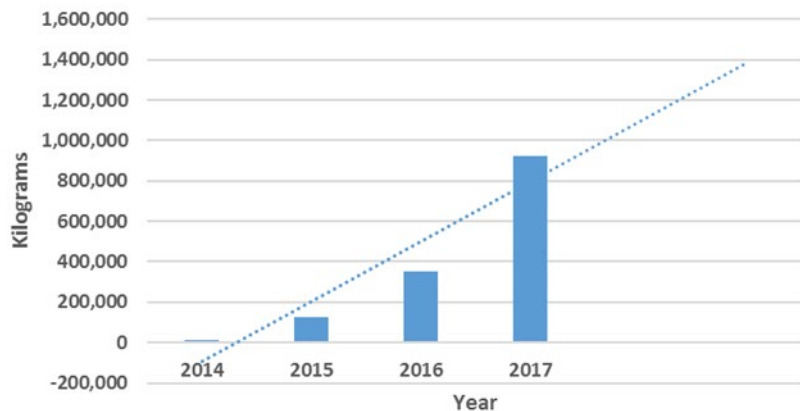


Small Farmers to Chefs

Benefits of Culinary Markets for Landrace Maize:

- Premium price for quality and diversity
- Small farmers directly targeted
- Promotes *in situ* conservation of maize landraces

Exportation of Native Maize



Training Farmer Groups to Connect to Export Markets

Grain Cleaning



Clave	nombre	Localidad	Municipio	Estado	fecha	Raza	Color	Cantidad (Kg)	No. de bolsas 25 kg	% humedad	Precio \$	Total a pagar	Total a pagar X Agricultor
EMEX-1	Ignacio Rosas Flores	Ayapango	Ayapango	Estado de México	año 2015	Chalqueño	Bianco				\$		
EMEX-2	Productores Fernando Jiménez Monte	San Cristóbal Poxtla	Ayapango	Estado de México	año 2015	Chalqueño	Azul				\$		
EMEX-3	ALBERTO SILVA GALICIA	Ayapango	Ayapango	Estado de México	Febrero 2016	Chalqueño	Azul	435	17	10.50%	\$ 9.00	\$ 3,825.00	\$ 5,850.00
					6/8/2016	Chalqueño	Azul	225	9	11.50%	\$ 9.00	\$ 2,025.00	
EMEX-4	Justina Cadena Gonzalez	Candelaria de Tapala	Chalco	Estado de México	Febrero 2016	Chalqueño	Amarillo Cl	400	16	8.20%	\$ 8.00	\$ 3,200.00	\$ 3,200.00
EMEX-5	Carmelo Lopez Paez	San Martín Pahuacan	Ayapango	Estado de México	4/13/2016	Chalqueño	Cremoso	200	8	12.6%	\$8.00	\$ 1,600.00	
EMEX-5	Carmelo Lopez Paez	San Martín Pahuacan	Ayapango	Estado de México	24/05/2016	Chalqueño	Cremoso	1300	52	9.9%	\$8.00	\$ 8,000.00	\$ 12,000.00
EMEX-6	Serapio Carlos Sanchez Diaz	San Martín Pahuacan	Ayapango	Estado de México	4/12/2016	Chalqueño	Cremoso	90	2	13.0%	\$8.00	\$ 400.00	
EMEX-6	Serapio Carlos Sanchez Diaz	San Martín Pahuacan	Ayapango	Estado de México	4/13/2016	Chalqueño	Cremoso	200	8	12.4%	\$8.00	\$ 1,600.00	
EMEX-6	Serapio Carlos Sanchez Diaz	San Martín Pahuacan	Ayapango	Estado de México	4/15/2016	Chalqueño	Cremoso	150	6	12.0%	\$8.00	\$ 1,200.00	\$ 11,200.00
EMEX-6	Serapio Carlos Sanchez Diaz	San Martín Pahuacan	Ayapango	Estado de México	4/18/2016	Chalqueño	Cremoso	100	4	11.60%	\$8.00	\$ 800.00	
EMEX-6	Serapio Carlos Sanchez Diaz	San Martín Pahuacan	Ayapango	Estado de México	5/23/2016	Chalqueño	Cremoso	1625	65	12.70%	\$8.00	\$ 13,000.00	
EMEX-6	Serapio Carlos Sanchez Diaz	San Martín Pahuacan	Ayapango	Estado de México	5/24/2016	Chalqueño	Cremoso	525	21	12.00%	\$8.00	\$ 4,200.00	
EMEX-7	Serapio Carlos Sanchez Diaz	San Martín Pahuacan	Ayapango	Estado de México	5/23/2016	Chalqueño	Azul	200	8	8.6%	\$9.00	\$ 1,800.00	\$ 1,800.00
EMEX-7	Juan Carlos Sánchez Franco	San Martín Pahuacan	Ayapango	Estado de México	4/12/2016	Chalqueño	Cremoso	50	2	11.2%	\$8.00	\$ 400.00	
EMEX-7	Juan Carlos Sánchez Franco	San Martín Pahuacan	Ayapango	Estado de México	4/13/2016	Chalqueño	Cremoso	775	31	11.0%	\$8.00	\$ 6,200.00	\$ 12,000.00
EMEX-7	Juan Carlos Sánchez Franco	San Martín Pahuacan	Ayapango	Estado de México	4/18/2016	Chalqueño	Cremoso	500	20	10.7%	\$8.00	\$ 4,000.00	
EMEX-7	Juan Carlos Sánchez Franco	San Martín Pahuacan	Ayapango	Estado de México	5/27/2016	Chalqueño	Cremoso	175	7	11.2%	\$8.00	\$ 1,400.00	
EMEX-8	Antonio Sánchez Diaz	San Martín Pahuacan	Ayapango	Estado de México				2	10.7%	\$8.00	\$ 400.00		
EMEX-8	Antonio Sánchez Diaz	San Martín Pahuacan	Ayapango	Estado de México				4	11.4%	\$8.00	\$ 800.00		
EMEX-8	Antonio Sánchez Diaz	San Martín Pahuacan	Ayapango	Estado de México				8	10.5%	\$8.00	\$ 1,600.00	\$ 10,600.00	
EMEX-8	Antonio Sánchez Diaz	San Martín Pahuacan	Ayapango	Estado de México				21	10.5%	\$8.00	\$ 4,200.00		
EMEX-8	Antonio Sánchez Diaz	San Martín Pahuacan	Ayapango	Estado de México				14	11.0%	\$8.00	\$ 2,800.00		
EMEX-8	Antonio Sánchez Diaz	San Martín Pahuacan	Ayapango	Estado de México				4	11.4%	\$8.00	\$ 800.00		
EMEX-9	Jaime Maximino Ariza Franco	San Martín Pahuacan	Ayapango	Estado de México	4/12/2016	Chalqueño	Cremoso	100	4	12.0%	\$8.00	\$ 800.00	
EMEX-9	Jaime Maximino Ariza Franco	San Martín Pahuacan	Ayapango	Estado de México	4/18/2016	Chalqueño	Cremoso	125	5	10.7%	\$8.00	\$ 1,000.00	\$ 3,800.00
EMEX-9	Jaime Maximino Ariza Franco	San Martín Pahuacan	Ayapango	Estado de México	4/19/2016	Chalqueño	Cremoso	250	10	10.3%	\$8.00	\$ 2,000.00	
EMEX-10	Fidel Lineres Torres	San Martín Pahuacan	Ayapango	Estado de México	3/12/2016	Chalqueño	Cremoso	50	2	11.0%	\$8.00	\$ 400.00	\$ 7,200.00
EMEX-10	Fidel Lineres Torres	San Martín Pahuacan	Ayapango	Estado de México	4/18/2016	Chalqueño	Cremoso	850	34	10.4%	\$8.00	\$ 6,800.00	

Record Keeping

Aflatoxin Testing



Hermetic Bagging



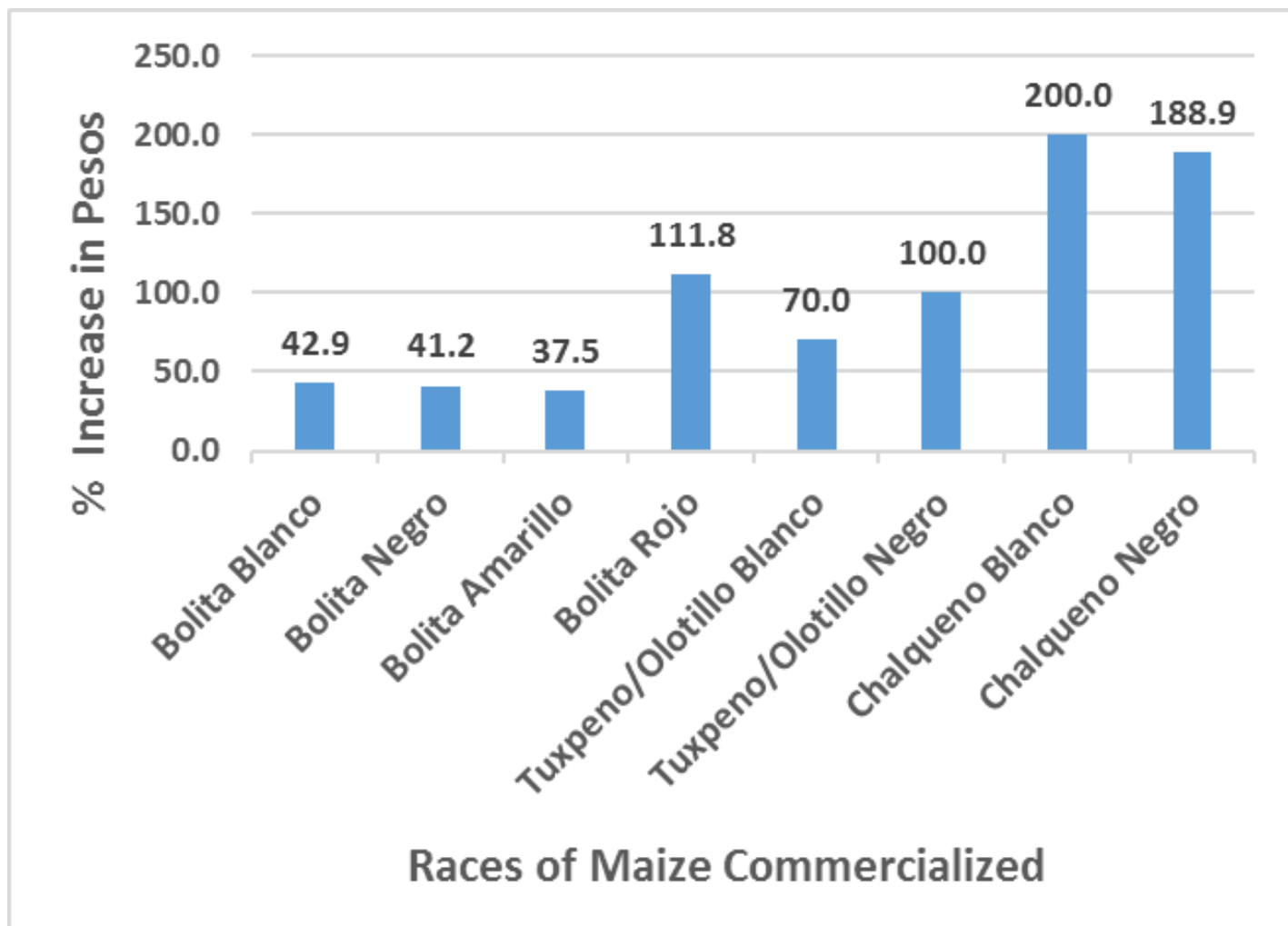
Storage



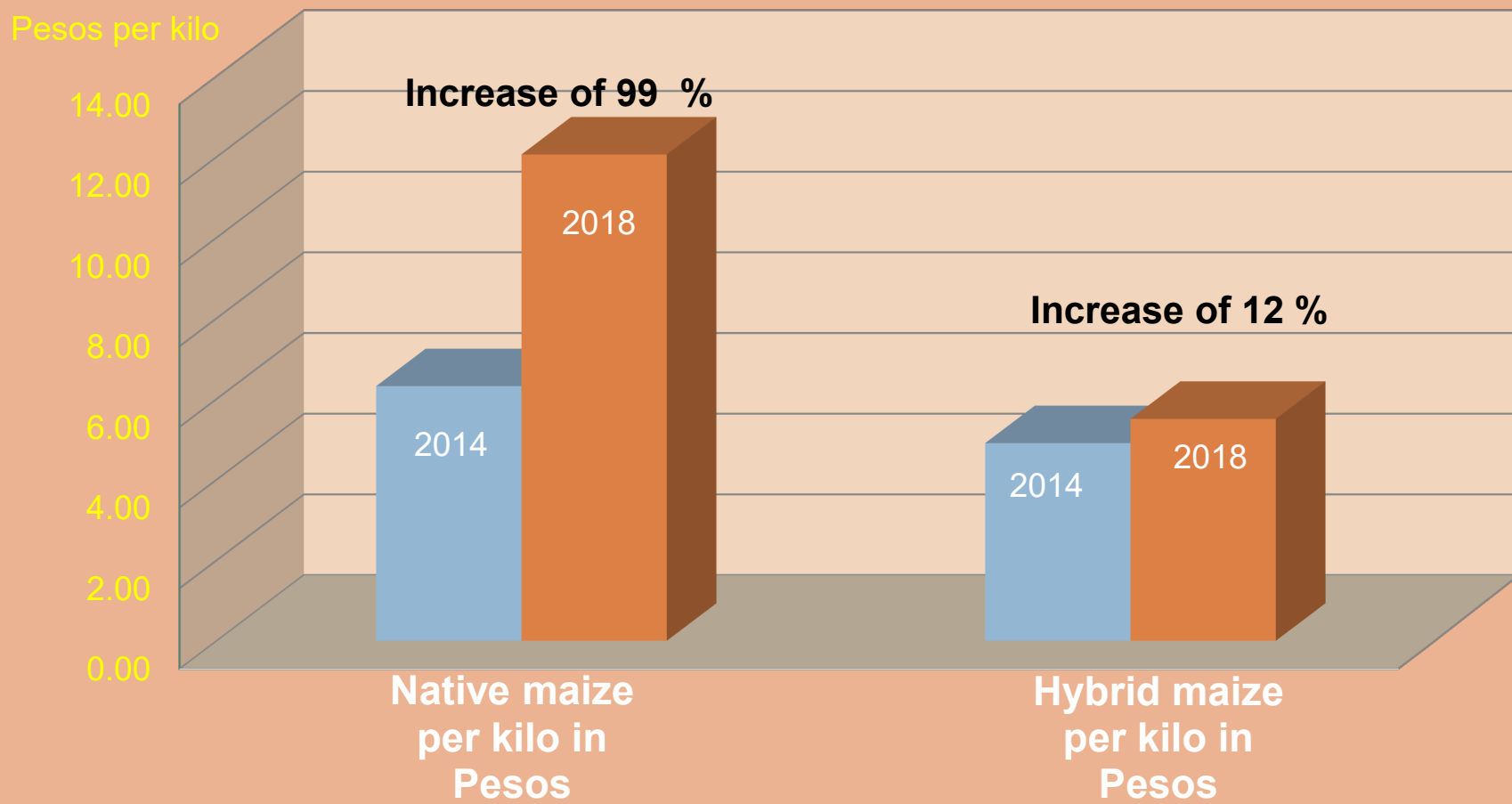
Expansion of Use of Native Maize in Culinary Markets



Effects of Expanding Culinary Markets on Native Maize Prices Paid to Farmers



CHANGE IN PRICES TO FARMERS FOR NATIVE MAIZE FROM INICIATION OF PROJECT TO 2018



How can we preserve and expand benefits to small scale traditional landrace farmers?



Commercialization Guidelines for Native Maize Landraces

Experts in Native Mexican Maize were convened to:

- Define standards for distinguishing native maize
- Form a panel of experts to identify native maize
- Define types of farmers and communities that can be targeted.





Amanda
Edelmira
Juan Manuel
Robert



--- La Asamblea, después de discutir la propuesta del Presidente, por unanimidad de votos, adoptó las siguientes:---
 ----- R E S O L U C I O N E S -----
 --- "1. En este acto se aprueba el cambio de denominación social de la Asociación a "ProMaíz Nativo A.C.", con efectos a partir de la presente."
 --- "2. En virtud de la resolución que antecede, en este acto, se modifica el Artículo Primero de los estatutos sociales de la Asociación, para quedar redactado de la siguiente manera: -
 --- ... "Artículo Primero. La denominación social de la Asociación será "ProMaíz Nativo", denominación que siempre irá seguida de las palabras "Asociación Civil" o de su abreviatura "A.C."...



Marca Colectiva for Maíces Nativos Productos de la Milpa



Signifying:

- Native Maize verified by experts
- Small holder farmer status verified
- Native Maize is documented to be grown in its historic area of distribution
- Price compensatory with the quality, rarity, and history of the maize

A National Collective Trademark approved for small native maize farmers..





Legal Formation and Tax Registration of Cooperative
Xhub Guldán Zegache

Costos de Producción

Destajar y desgranar a mano \$60/canasto (16 canastos 1 ton)

Limpieza del grano 2 jornales \$1,000/ha
4 jornales si esta muy sucio

\$13,500/ha hasta \$15,550/ha
Rendimiento ton/ha

Blanco 2 ton - 1.5 ton - 0.5 ton
El mercado quiere blanco, promedio de venta es \$30

Negro 2 ton - 1.5 ton

Amarillo 2 ton

Belotore 1.5 ton

Depende del temporal, el tipo de tierra, humedad que absorbe y dura en el suelo

\$10.4/Kg } Precio piso

Pequeño productor de equilibrio
2500 - 5000 m² producen principalmente para el autoconsumo
6-10 ha } Producen para vender

Costos de Producción ha

Barbecho 1200

Kastra 800

Siembra 1500 }
900

Con maquinaria

Deshierbe 800 }
pasar con el tractor.

(moza endoera 2200 }
la milpa) mil doscientos

18-46-00 3 bultos 550 bulto 1650

3 bultos UREA 320 bulto 960

2 bultos de urea y 1 de 18-46-00 640+550 1,190

Limpieza 800-1,000

Corte de zacate 2,000

Pizza (6 a 8 personas) 130 x 6 } 1200
\$250 por día 150 x 6 }

40 desayuno 280 } 1,800
40 comida

Flete 300 camion

4 a 5 personas 130 por día + 200 comida (2 comedores)

Destajadora 1,650 }
y 300 por bulto de 50 kg. 2,300/ha
Desgranadora de mano

300 yunta rentada 1ha son 2 mañanas

2000 + 1200 para comida

La yunta o tractor lo tapa



COSTOS DE PRODUCCIÓN 2018

Labores a realizar	fuentes y/o herramientas	cantidad	costos	
			min	mas \$ por max
barbecho	maquinaria	1 ha	1200	
rastra	maquinaria	1 ha	800	
siembra	Yunta mas 4 mosos	1 ha	1600	
	maquinaria	1 ha	900	600
Deshierbe	maquinaria+ mosos	1 ha	800	
fertilización	3 de 18-46 fosfato diamonico	1 ha	1650	
	3 de 46-0-0 Urea	1 ha	960	
	2 urea+ 1fosfato diamonico	1 ha	1190	
Deshierbe por mata	manual	1 ha	800	200
corte de zacate	manual	1 ha	2000	
Pizar labor	6 a 8 personas 250/por dia	1 ha	1500	500
Comida labor de Pizca	6 a 8 personas 80/por dia	1 ha	480	160
Flete	vehiculo mas 4 gente para cargar	1 ha	300	
Deshojar y desgranar	manual	1 ha	2300	
Limpieza de grano	manual	1 ton	1000	
		Total	\$15,740.00	\$17,600.00

Pricing of Native Maize Based on Farmer Costs and Yield in Optimal and Suboptimal Years

Farmer Profit for Native Maize under Drought Stressed and Optimal Rainfall Scenarios

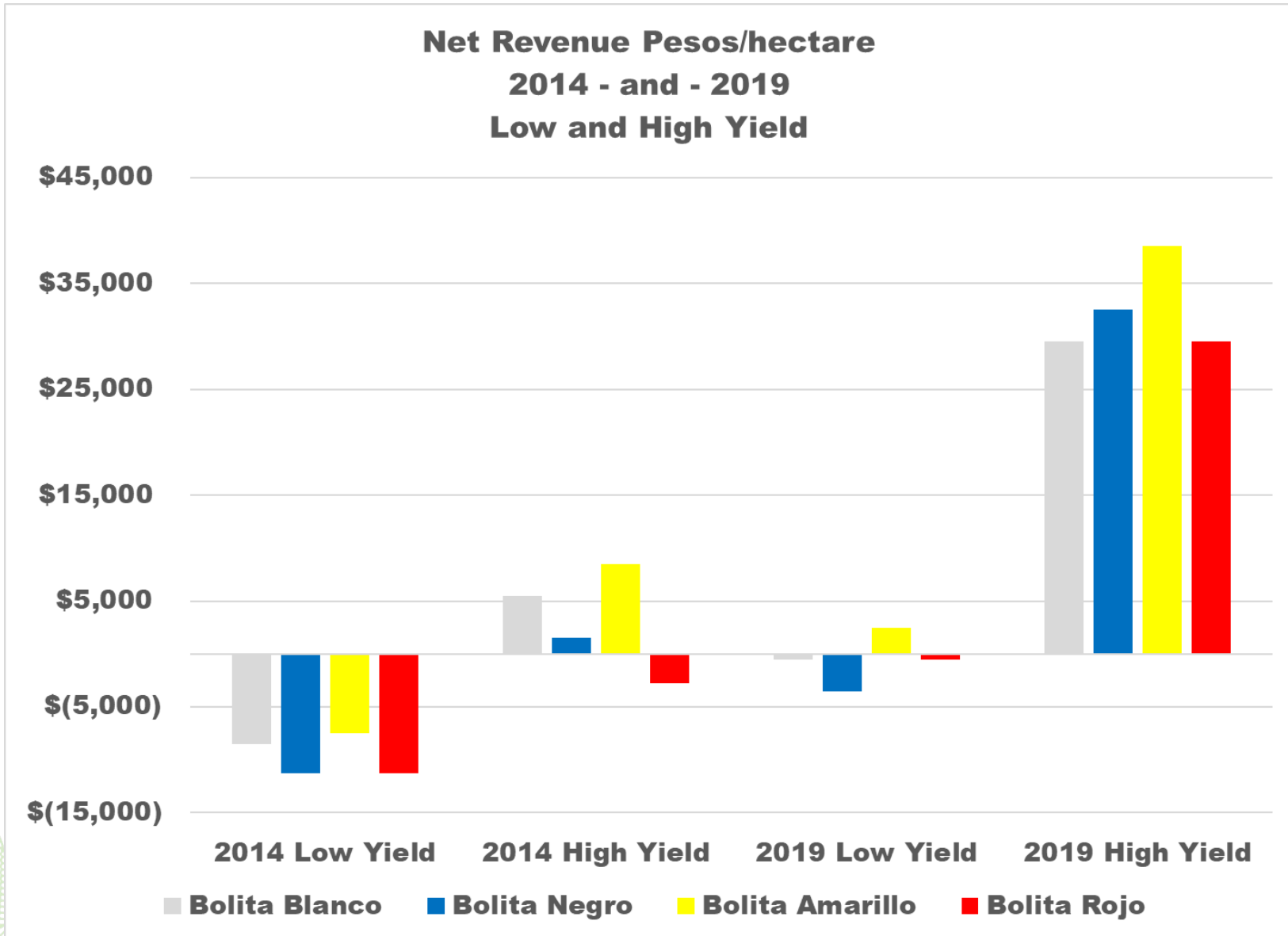
	Price Pesos/kg		Increase to Farmer	Yield kg/hectare		Net Revenue Pesos/hectare 2014		Net Revenue Pesos/hectare 2019	
	2014	2019	2014 - 2019	Low	High	Low	High	Low	High
Bolita Blanco	7.00	15.00	114%	1,000	3,000	\$ (8,500)	\$ 5,500	\$ (500)	\$29,500
Bolita Negro	8.50	24.00	182%	500	2,000	\$ (11,250)	\$ 1,500	\$ (3,500)	\$32,500
Bolita Amarillo	8.00	18.00	125%	1,000	3,000	\$ (7,500)	\$ 8,500	\$ 2,500	\$38,500
Bolita Rojo	8.50	30.00	253%	500	1,500	\$ (11,250)	\$ (2,750)	\$ (500)	\$29,500

Costs of production:

\$15,500/hectare



Educating Buyers on Farmers Costs and Yield by Grain Color Variants



Conservation of Genetic and Cultural Resources





Thank you !



 CIMMYT^{MR}

Thanks to the team!



Sr. Pedro Velazquez

M.C. Neftali Cruz

Ing. Jose Luis Roque

Sr. Miguel Heredia



Community and Municipality	Elevation (masl)	Slope	Environment	Maize Race	Indigenous Group	% of the population in extreme poverty
Santa María Yolotepec, Juquila, Oaxaca	2040	Hillslopes	Transition Zone	Comiteco	Chatinos	50.2
Santiago Yaitepec, Santigo Yaitepec, Oaxaca	1800	Hillslopes	Transition Zone	Comiteco	Chatinos	46.04
Santa Maria Roalo, La Trinidad Zaachila, Oaxaca	1502	Flat	Semi-Arid Subtropical	Bolita	Mestizos	25.6
Santa Ana Zegache, Santa Ocotlan de Morelos, Oaxaca	1,481	Flat	Semi-Arid Subtropical	Bolita	Zapotecos de Valle	29.16
Mandimbo, San Miguel del Puerto, Oaxaca	350	Hillslope	Semi-Arid Tropical	Conejo, Tuxpeno and Olotillo	Mestizos	47.8
El Zanjon, Villa Tututepec de Melchor Ocampo, Oaxaca	60	Flat to rolling	Semi-Arid Tropical	Conejo, Tuxpeno and Olotillo	Mixtecos y Mestizos	20.94
Santa María Tonameca, Pochutla, Oaxaca	40	Flat	Semi-Arid Tropical	Conejo, Tuxpeno and Olotillo	Mixtecos y Mestizos	56.6

Community and Municipality	Elevation (masl)	Slope	Environment	Maize Race	Indigenous Group	% of the population in extreme poverty
Jazmín Morelos, Santiago Apoala, Oaxaca	2,409	5 - 25%	Semi-arid Highlands	Chalqueño and Conico	Mixteco	49.3
San Antonio Nduayaco, Santiago Apoala, Oaxaca	2,334	5 - 25%	Semi-arid Highlands	Chalqueño and Conico	Mixteco	49.3
Trinidad Ixtlán, Santiago Xiacuí, Oaxaca	2,265	5 - 35%	Humid Highlands	Oloton, Elotes Occidentales	Zapotecos de la Sierra	8.1
Santa Maria Yavesia, Santa Maria Yavesia, Oaxaca	2,083	5 - 35%	Humid Highlands	Conico x Bolita, Elotes Occidentales, Serrano	Zapotecos de la Sierra	13.13
Pahuacan, Ayapango, Edo. de Mexico	2,483	Flat	Humid Highlands	Chalqueño	Mestizos	8.4
San Felipe de los Herreros, Charapan, Michoacán	2,200	Flat	Humid Highlands	Mushito and Purepecha	Purepecha and Mestizo	35.9
Cherán-Atzicuirín, Michoacán	2,200	Flat	Humid Highlands	Mushito and Purepecha	Purepecha	25.2